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EXAMINER	
WERNER, BRIAN P	

ART UNIT	PAPER NUMBER
2621	

DATE MAILED: 02/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	**Application No.** 10/032,272	**Applicant(s)** SONG ET AL.	
	Examiner Brian P. Werner	**Art Unit** 2621	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 October 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 13-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 13-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. The arguments received on October 1, 2004 have been entered. Claims 1-9 and 13-45 remain pending.

Response to Arguments

2. Each of the remarks and/or arguments filed with the aforementioned amendment have been considered:

The Ortiz reference

Summary of Applicant's Remarks at response pages 9-10:

"Ortiz et al. Does not teach analyzing each image separately."

Examiner's Response:

Ortiz discloses the detection and extraction of discrete anomalies (figure 11, numeral 112; also see figure 12; each image of the "video signal" at column 7, line 3, is analyzed for the presence of a defect). Ortiz determines "whether or not there are any defects in the cable jacket as the cable passes" at column 6, line 62. Ortiz states, "whenever a defect occurs in the natural polyethylene, the magnitude of the video signal changes" at column 7, line 5. The "motion detector circuits 112 detect these variations" at column 7, line 7. Looking at figure 11, there are

as many motion detector circuits as there are cameras, with each detector responding to its associated camera signal. Therefore, each camera image is analyzed separately. Regarding the "analysis" or "analyzing" limitation, each motion detector accepts the video signal of its corresponding camera as input. Without some sort of analysis, noting would be achieved. The Ortiz motion detectors take the video signals and analyze each of them, separately, for the presence of a magnitude change as depicted in figure 12.

Summary of Applicant's Remarks at response pages 9-10:

"there is no analysis, or 'methodical examination' of any one signal magnitude by itself"

Examiner's Response:

As explained above, each the image from each camera is input into its own, dedicated motion detector. The motion detector must determine whether or not a signal magnitude exceeds a point, or a threshold, in order to trigger the system to record a defect. Without an analysis of the ever changing video signal (i.e., the cable is moving), this would not be possible. Thus, some sort of analysis is taking place. The analysis must be individual, or specific to the individual camera image, in that the motion detectors are not connected with one another as depicted in figure 11. Each individual camera image is analyzed separately.

The Ortiz and Kanzaka combination

Summary of Applicant's Remarks at response page 12:

"Kanzaka … necessitates changing the entire principle of operation of Ortiz et al.".

Examiner's Response:

Disagreed. The operating principle of Ortiz remains entirely unchanged by the Kanzaka teaching. What does change is the hardware and/or software that implements the operation of Ortiz. That is, it would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the defect detection and recording circuitry of Ortiz at figure 11, numerals 112, 116 and 126, the computer image analysis processor taught by Kanzaka (i.e., figure 1, numeral 3). That is, in place of the individual circuits of Ortiz, it would have been obvious to utilize a programmed image processor to implement the same tasks. The principle of detecting defects on tubing in motion as taught by Ortiz does not change. The only difference is that the analysis of images for defects (i.e., that exceed a magnitude) of Ortiz is now performed by a programmed image processor or computer.

Summary of Applicant's Remarks at response page 12:

"Kanzaka … does not teach analyzing or processing each image separately".

Examiner's Response:

Disagreed. Kanzaka does not have to because Ortiz does, as explained above. However, Kanzaka states that "an image or video signal v from the video camera 2 is processed by an inspection machine 3 that is an electronic processor to inspect the existence or not of defects ..." at column 2, line 60. Thus, it is an "image" that is processed to detect flaws. Also, it is well known that a "video" signal comprises a sequence, or series of images. From the Kanzaka reference taken as a whole, there is no indication that a plurality of "images" are processed together, or as a group. All indications are that individual images are processed separately, or one at a time, to detect defects.

The McCoy, Kanzaka and Morrison Combination

Summary of Applicant's Remarks at response page 17:

Kanzaka "necessitates changing the entire principle of operation of McCoy et al."

Examiner's Response:

Disagreed. McCoy requires a "sensor 52 [that] senses one or more characteristics of parameters of the coiled tubing at a particular location" (McCoy column 5, line 3), including "dents, wall thinning, cracks", etc. (McCoy column 5, line 33) and Kanzaka teaches a sensor and image processing equipment that can achieve that goal. McCoy is open to different types of sensing arrangements, stating that "particular coiled tubing and test apparatus are neither the present invention nor limiting ..." at column 5, line 42. There is absolutely no change in the

operating principle of McCoy in this combination. This is a simple substitution of an input sensor to achieve and fulfill that stated goals of McCoy.

Summary of Applicant's Remarks at response page 18:

Kanzaka does not "teach analyzing or processing each image separately".

Examiner's Response:

Disagreed. Kanzaka does teach this as explained above. In addition, Morrison teaches this as further explained in the rejection.

Claim 26: The Puffer and Morrison Combination

Summary of Applicant's Remarks at response pages 21-23:

Morrison "necessitates changing the entire principle of operation of Puffer", and "the analysis performed by Morrison et al. were incorporated into Puffer, this would impermissibly completely change Puffer's principle of using light reflected onto pixels to detect defects on the surface of the inspection object". The stated combination would "render Puffer unsatisfactory for its intended purpose".

Examiner's Response:

Disagreed. It appears, from the arguments, that the applicant assumes the entire disclosure of Morrison is somehow fully incorporated into the Puffer reference. This is simply

not the case. The Morrison reference is relied upon as a "teaching", where a concept is taught. The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). To assist the applicant a little further, the combination will again be explained.

Puffer teaches the essence of he claim. However, Puffer does not teach a computer processor having pattern recognition software to perform the extraction of discrete anomalies, and puffer does not teach a separate output device producing video signals of the tubing and an input device receiving the video signals and generating sequential images of the tubing surface from the video input.

Morrison is relied upon as teaching a video camera, frame grabber and pattern recognition software. The tasks that Morrison's pattern recognition software currently perform are absolutely irrelevant. Morrison teaches the concept of a frame grabber for interfacing a camera with a computer, and the concept of a programmed computer performing pattern recognition to detect defects. In the combination, it would have been obvious to replace Puffer's antiquated circuitry as depicted at figure 2 with this more modern approach. No principle of operation is changed, just the hardware/software. Puffer would still acquire an image signal and extract defects from that signal. One skilled in the art would be motivated to make this modification for the following reasons:

In order to conveniently capture individual images for processing as required by Puffer quickly and efficiently without the need for any specialized hardware as currently disclosed by Puffer;

The video camera and frame grabber of Morrison are commonly available, off-the-shelf items as described at section 6 of Morrison (i.e., column 7, lines 5-51), thus reducing the cost associated with specialize, custom camera and processors;

The ability to "collect the video information sufficiently quickly that the spatial resolution of the camera is not degraded, and to digitized the information into a large range of numbers representing brightness or gray levels" (Morrison, column 7, line 10), thus producing an accurate image in a short period of time; and

Because of the ability to store the images "in a dedicated area of memory" (Morrison, column 7, line 27) which offers "higher overall system speed" (Morrison, column 7, line 34), thus providing the McCoy and Kanzaka combination with the ability to accurately process more images to ensure that no defects on the moving tubing are missed.

Summary of Applicant's Remarks at response page 23:

"Morrison et al. Analyzes an image to determine the position of the edge of the items being analyzed" and this would "render Puffer unsatisfactory for its intended purpose".

Examiner's Response:

Morrison is not relied upon in the combination as teaching anything other than a modern approach to image processing, including a video camera, frame grabber and pattern recognition

software. The fact that Morrison teaches edge detection is irrelevant to the combination. The references are not literally combined. Rather, it is the teaching of Morrison that is combined to modify the Puffer reference.

Summary of Applicant's Remarks at response page 23:

"Puffer does not disclose extracting discrete anomalies of the tubing surface from images of the tubing surface".

Examiner's Response:

Refer to figure 2, numeral 52. The "counter 52 increments each time a pixel senses light above the threshold level, and provides an output 55 to an annunciator or alarm 56 each time [a] preselected count (i.e., 16) is reached" where "the count is one indicative of a flaw such as a pip 22" at Puffer column 6, lines 1-5. The "cumulative count during each scanning frame corresponds to the size of the image on detector 38, and may correspond to the size of a pip 22" at column 6, lines 10-14. A "flaw" as described by Puffer is a discrete anomaly, and it is extracted from a "scanning frame". Thus, discrete anomalies are extracted from images.

<u>Claim 36: The McCoy, Kanzaka, Newman, Reis and Ortiz Combination</u>

Summary of Applicant's Remarks at response page 21:

"Applicants request that the Examiner clarify the status of claim 36."

Examiner's Response:

Claim 36 was art rejected in the previous Office Action, and remains so herein.

Claim 13: The Lam, Kanzaka and Newman Combination

Summary of Applicant's Remarks at response page 31:

Modifying Lam based on Kanzaka "necessitates changing the entire principle of operation of Lam" because "Lam uses the principle of comparing electromagnetic signal magnitudes to determine when there has been a change in the signal", Kanzaka teaches "processing or analyzing each image separately", and there "would be no motivation to combine".

Examiner's Response:

First, both Lam and Kanzaka are in the field of endeavor of inspection; particularly the inspection of moving bodies for defects. The art is analogous.

Second, Lam is in no way limited to his preferred embodiment with respect to the method of measurement (i.e., "electromagnetic signal" as described by the applicant). The principle of Lam is one of inspecting the entire circumference of a moving coiled tube and providing a way for an operator to visualize the results. Lam inspects for "inclusions, gouges", "mechanical damage, pitting and fatigue cracks" as described at column 1, lines 20-21 and 40. This principle does not depend upon the type of sensor or measurement device used. Any device that is capable of detecting these types of defects would be suitable for Lam. In fact, Lam teaches that any type

of inspection device "capable of generating a suitable defect signal" can be used (Lam, column 5, line 38). That is, Lam states that "the teachings of this invention are equally applicable for use with radiation inspection apparatus ... or any other inspection apparatus capable of generating a suitable defect signal 24" at column 5, line 37. Lam even suggests "visual inspection" at column 6, line 52. Lam is NOT limited to a particular type of inspection sensor. Thus, by incorporating the teaching of Kanzaka, there is no change in Lam's ability to inspect the circumference of a moving coiled tube and provide a way for an operator to visualize the results. Lam is OPEN to virtually any type of inspection sensing device as long at it provides "suitable" results. Kanzaka teaches one such type of inspection as described in the combination. The principle of operation has not changed. As far as motivation, the examiner has provided ample such motivation in the previous Office Action, including:

The computer processors of Kanzaka are faster than discrete analog circuitry, and the algorithms can be modified, updated or changed without major hardware adjustments;

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time; and

Recognizing unwanted defects ("X marks … cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks … may be ignored" at column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and reduce the downtime association with an operator having to review surface conditions that are not serious, and will not cause failure.

The Lam and Kanzaka combination is proper and well founded.

Allowable Subject Matter

Summary of Applicant's Remarks at response page 31:

In January 2004, the "Examiner objected to claim 36 as being dependent upon a rejected base claim" and applicant's "amended claim 36 into independent form". The "applicants respectfully request that the rejection be removed and that the amended claim 36 be allowed."

Examiner's Response:

In the non-final rejection issued on January 20, 2004, claim 36 was objected to. In the claim amendment received on April 20, 2004, the applicant did place claim 36 in independent form. On July 7, 2004, the examiner issued another NON-FINAL office action with claim 36

being rejected over prior art. New art and a new combination of references was discovered by the examiner that necessitated a new grounds of rejection. Thus, the office action was properly made NON-FINAL on the second action giving the applicant an opportunity to respond to the rejection. Applicant's request that "the rejection be removed" is denied. A response to the applicant's arguments appears above.

In re Ratti – Changing a Principle of Operation

The applicant has relied upon In re Ratti for virtually every argument in the response. For example, at response page 7, the applicant states, "if the proposed modification or combination of the prior art would change the principle of operation of the prior rat invention being modified, then the teaching of the references are not sufficient to render the claims prima facie obvious". The case In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959) is cited. The applicant repeats this again at response pages 16, 21 and 30.

In Ratti, the primary reference relied upon in a combination disclosed an oil seal where a bore engaging portion was reinforced by a cylindrical sheet metal casing requiring rigidity for operation. The claimed invention being examined required resiliency and the examined south to modify the primary reference to be resilient. However, the primary reference taught away from such resiliency as it required "rigidity". This type of combination changes a fundamental operating principle of a primary reference. None of the combination advanced by the examiner here even come close to such a modification.

For example, in the case of claim 13, the applicants argued at response page 31 that Modifying Lam based on Kanzaka "necessitates changing the entire principle of operation of

Lam" because "Lam uses the principle of comparing electromagnetic signal magnitudes to determine when there has been a change in the signal", Kanzaka teaches "processing or analyzing each image separately", and there "would be no motivation to combine".

However, Lam is in no way limited to his preferred embodiment with respect to the method of measurement (i.e., "electromagnetic signal" as described by the applicant). The principle of Lam is one of inspecting the entire circumference of a moving coiled tube and providing a way for an operator to visualize the results. Lam inspects for "inclusions, gouges", "mechanical damage, pitting and fatigue cracks" as described at column 1, lines 20-21 and 40. This principle does not depend upon the type of sensor or measurement device used. Any device that is capable of detecting these types of defects would be suitable for Lam. In fact, Lam teaches that any type of inspection device "capable of generating a suitable defect signal" can be used (Lam, column 5, line 38). **That is, Lam states that "the teachings of this invention are equally applicable for use with radiation inspection apparatus ... or any other inspection apparatus capable of generating a suitable defect signal 24" at column 5, line 37. Lam even suggests "visual inspection" at column 6, line 52. Lam is NOT limited to a particular type of inspection sensor.** Thus, by incorporating the teaching of Kanzaka, there is no change in Lam's ability to inspect the circumference of a moving coiled tube and provide a way for an operator to visualize the results. **Lam is OPEN to virtually any type of inspection sensing device as long at it provides "suitable" results.** Kanzaka teaches one such type of inspection as described in the combination. The principle of operation has not changed.

This combination is in no way analogous to the fact situation of In re Ratti; nor are any of the other combinations advanced by the examiner herein. In re Ratti is simple not applicable.

Taken to the extreme that the applicant has taken Ratti herein, no combination would be proper. Ratti was not intended to obviate 35 U.S.C. 103. Rather, Ratti is applicable when a modification changes a fundamental and critical manner of operations of a reference, such as changing the rigid and non-resilient casing to one that is resilient as in Ratti. The examiner's combinations in no way approach this extreme.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 15, 17, 18, 21 and 31 are rejected under 35 U.S.C. 102(b) as being anticipated by Ortiz et al. by (US 4,988,875 A).

Regarding claim 15, which is representative of claim 31, Ortiz discloses:

plural imaging devices (figure 11, numerals 36; "120 degrees from each other, can provide view of the entire bulk of the cable jacket" a column 6, line 58) capturing video images ("video camera" at column 4, line 33) of coiled tubing (figure 1, numeral 20; figure 11, numeral 105 designating the same; the inspection system examines a "jacket" that is coiled as depicted in figure 1, and the "jacked" is a tubing because it is hollow on the inside; the claim does not preclude the tubing from being filled, such as with a copper wire in the Ortiz reference); and

a computer analyzing each image separately extracting discrete anomalies (figure 11, numeral 112; also see figure 12; each image of the "video signal" at column 7, line 3, is analyzed for the presence of a defect; "determine whether or not there are any defects in the cable jacket as the cable passes" at column 6, line 62; "whenever a defect occurs in the natural polyethylene, the magnitude of the video signal changes" at column 7, line 5; and the "motion detector circuits 112 detect these variations" at column 7, line 7; looking at figure 11, there are as many motion detector circuits as there are cameras, with each detector responding to its associated camera signal; therefore, each camera image is analyzed separately) and generating an indication if an anomaly is a defect (e.g., "time delayed signal representing the occurrence of any defect" at column 7, line 13; "location of the cable area being documented" at column 7, line 40). Regarding the "analysis" or "analyzing" limitation, each motion detector accepts the video signal of its corresponding camera as input. Without some sort of analysis, noting would be achieved. The Ortiz motion detectors take the video signals and analyze each of them, separately, for the presence of a magnitude change as depicted in figure 12.

Regarding claim 17, the cameras are CCDs ("CCD" at column 4, line 25).

Regarding claims 18 and 21, a video stacker correlates images (figure 11, numerals 124 and 126; "combines signals from up to four video cameras sources into four video signal windows at its output" at column 7, line 31) with a longitudinal position using a counter signal (figure 11, numeral 116; "location of the cable area being documented" at column 7, line 40).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 15, 17, 18, 21, 22, 23, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A).

Regarding claims 15 and 31, even if Ortiz did not discloses a computer that analyzes individual images in order to determine the presence of a defect as argued by the application at response page 11, computer implement image analysis for purposes of defect detection is well known, and would have been obvious in view of Kanzaka as described below.

Kanzaka discloses a system in the same field of optical defect inspection (see figure 1), and in the same problem solving area of detecting and recording defects on a moving body (figure 1, numeral 1), comprising computer analysis of individual images in order to determine the presence of a defect (figure 1, numeral 3; "An image or video signal v from the video camera 2 is processed by an inspection machine 3 that is an electronic processor to inspect the existence or not of defects such as flaws, dirty or the like on the surface of the inspected object" column 2, lines 59-62). In summary, Kanzaka inspects a material as it moves (i.e., figure 1, numeral 1) by capturing video images (figure 1, numeral 2), and analyzing the images to provide a defect "detection signal d" (column 3, line 2), produce "necessary data D" including "location … as well as size" (column 3, line 6), and provide a "composing signal C formed of the data D and the

video signal v" (column 3, line 42) along with "the inspection date, product type, lot number etc." (column 3, line 48) and the "distance" in the "length direction of the inspected object" (column 3, lines 55-66). Kanzaka then sorts "the grades of the defects on the inspected object 1" (column 4, line 36). The Kanzaka system does essentially what Ortiz does via. the circuitry at figure 1, except that Kanzaka's system is computer implemented and much more comprehensive in the data it gathers.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the defect detection and recording circuitry of Ortiz at figure 11, numerals 112, 116 and 126, the computer image analysis processor taught by Kanzaka (i.e., figure 1, numeral 3). One would be motivated to utilize the processor of Kanzaka for the following reasons:

Computer processors are faster than discrete analog circuitry, and the algorithms can be modified, updated or changed without major hardware adjustments;

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time; to

Recognizing unwanted defects ("X marks ... cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks ... may be ignored" at column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and reduce the downtime association with an operator having to review surface conditions that are not serious, and will not cause failure.

Regarding claim 17, Ortiz disclosed three CCD cameras surrounding the tubing ("three ... cameras" at column 6, line 55) and the Ortiz/Kanzaka combination does not change this. The combination utilizes the image signals from the Ortiz cameras as input into the computer analysis system of Kanzaka.

The requirements of claims 18 and 21 are met by the Ortiz and Kanzaka combination described above. That is, Kanzaka teaches a video stacker ("video signal v and the data D from the video processor unit 5 are mixed to provide a composing signal C which is delivered to a video signal recorder unit 8; this is done for each detected defect; thus, the detected defects are stacked on recorder unit 8) correlating images with a longitudinal position using a counter signal ("such distance data will be contained in the data D" at Kanzaka column 3, line 66). It would have been obvious to provide such stacked data regarding any defects detected in the Ortiz system for the same reasons cited above, as well as to be able to locate the actual defect on the tubing to either correct it, or removed it before it causes a failure in the field.

Regarding claim 22, the Kanzaka system as well as the Ortiz system both detect and output defects as the inspection articles are conveyed, and thus both detect defects in real time. Likewise, the Ortiz and Kanzaka combination detects defects in real time.

Regarding claim 23, Ortiz teaches storing video images for later defect identification at figure 11, numeral 126. The images are stored for later manual inspection by an operator. The Ortiz and Kanzaka combination does not change this aspect of Ortiz, except that a more comprehensive collection of data concerning the defects are stored per Kanzaka figure 1, numeral 10, as described above.

Regarding claim 32, the Ortiz and Kanzaka combination provides a warning event (Kanzaka teaches storing only data regarding defects, when they are detected, at figure 1, numeral 10, displaying the data at numeral 12, as well as outputting the data on a strip chart at numeral 9, as depicted in figure 2).

7. Claim 41 is unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A) as applied to claim 31, and further in combination with Puffer (US 4,563,095 A).

While the Ortiz and Kanzaka combination processes images to detect defects, the combination does not teach determining if the size of a discrete anomaly exceeds a user-defined threshold.

Puffer discloses a system for visually inspecting coiled tubing (figure 1), comprising determining if the size of a discrete anomaly exceeds a user-defined threshold (figure 2, numeral 52; "counter 52 increments each time a pixel senses light above the threshold level, and provides

an output 55 to an annunciator or alarm 56 each time [a] preselected count (i.e., 16) is reached" where "the count is one indicative of a flaw such as a pip 22" at column 6, lines 1-5; "the cumulative count during each scanning frame corresponds to the size of the image on detector 38, and may correspond to the size of a pip 22" at column 6, lines 10-14)

It would have been obvious at the time the invention was made to one of ordinary skill in the art to adapt the flaw detection processor of the Ortiz and Kanzaka combination to determine if the size of a discrete anomaly exceeds a user-defined threshold as taught by Puffer, in order to provide a size criteria for the indication of real defects, thus preventing the false indication of a defect ("falsely indicate" at Puffer column 6, line 35).

8. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A) as applied to claim 15 above, and further in combination with Newman (US 6,321,596 B1).

Claim 24 requires a longitudinal stripe on the outer surface of the tubing. The remainder of the claim, "for the purpose of", is an intended use limitation and does not constitute a positively recited structure element, or a step. Thus, is afforded no weight.

The Ortiz and Kanzaka combination does not teach a longitudinal stripe on the outer surface of the tubing.

Newman teaches a system for inspecting coiled tubing (figure 1) comprising a longitudinal stripe on the outer surface of the tubing ("a visible line is marked along the coiled tubing" at column 3, line 42). The purpose of this stripe as described by Newman is as a reference mark, for visual monitoring via. a camera, from which to monitor tubing characteristics

such as rotation ("coiled tubing can be marked and locations of markings can be measured in a variety of ways", "rotational orientation of the line ... is monitored visually, with ... camera(s)" at column 3, lines 40-45; "take discrete rotational measurements at one or at a plurality of locations on a length of coiled tubing while it is being unspooled" at column 3, line 23; the rotation of the tube is a measure of "fatigue damage" at column 4, line 25).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the tubing of the Ortiz and Kanzaka combination with at least one longitudinal stripe for purposes of measuring rotational orientation of the tubing, thereby ensuring that the tubing has not been fatigued by undue amounts of rotation.

9. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A) as applied to claim 15 above, and further in combination with Hametner et al. (US 5,046,852 A).

Claim 25 requires the pattern recognition software to measure outside diameter of the tubing and indicate whether it is outside a user-defined tolerance.

The Ortiz and Kanzaka combination does not teach the measurement of diameter.

Hametner discloses a system in the same field of optical tube inspection ("tube material" at column 1, line 52; "optically scanned" at column 2, line 36), comprising the pattern recognition software (the system is computer implemented, and measurements are made by image processing) to measure outside diameter of the tubing ("diameter" at column 1, line 53, and elsewhere) and indicate whether it is outside a user-defined tolerance ("conforms to a desired

configuration" at column 2, line 35; "desired configuration within a predetermined tolerance" at column 2, line 44).

It would have been obvious at the time the invention was made to one of ordinary skill in the art adapt the pattern recognition software of the Ortiz and Kanzaka combination to include, as a further measurement of the tube's physical condition, the outside diameter as taught by Hametner, in order to ensure further ensure conformity with design standards and to ensure a proper tube thickness to prevent failure during use.

10. Claim 16 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A) as applied to claim 15 above, and further in combination with Greenwood et al. (US 3,770,111 A).

The Ortiz and Kanzaka combination does not teach the use of fiber optic image devices.

Greenwood discloses an optical inspection system wherein Greenwood teaches the use of fiber optic imaging devices ("fiber light guides" at column 3, line 58).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the fiber optic image devices of Greenwood, in order to capture the images required by the Ortiz and Kanzaka combination, in order to "gather light over a much larger portion" of the tubing (Greenwood, column 4, line 1) with "a considerable decrease in optical complexity" (Greenwood, column 4, line 4), thereby providing an accurate and detailed image using a less complex, less prone to failure and lower cost image system.

11. Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Ortiz et al. by (US 4,988,875 A) and Kanzaka et al. (US 5,680,473 A) as applied to claim 18 above, and further in combination with Chiu et al. (US 6,031,931 A).

While the Ortiz and Kanzaka combination teaches a "position detector 1' such as a rotary encoder" (Kanzaka column 3, line 60) for detecting the position of the tubing in the movement direction, Ortiz and Kanzaka does not teach disabling or enabling the inspection system based on sensor speed.

Chiu discloses a system for inspecting an elongated body in motion (figure 3), comprising a counter ("cycle detector" and "encoder" at column 6, line 5) receiving location data indicating a position of a defect ("position" at column 6, line 28) and disabling or enabling the inspection system based on sensor speed ("beginning of a cycle" at column 6, line 6; "synchronize camera operation with movement" at column 6, line 37).

It would have been obvious at the time the invention was made to one of ordinary skill in the art utilize the rotary encoder of the Ortiz and Kanzaka combination, to enable and disable the image capture and inspection in order to automatically begin and continuously synchronize the camera operation with the movement to obviate the capture of to many or to few images for inspection.

12. Claims 1-3, 5-7 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A) and Kanzaka et al. (US 5,680,473 A), and further in combination with Morrison et al. (US 5,033,096 A).

Regarding claim 1, McCoy discloses an inspection system for coiled tubing employed in a well (figure 4; "as the coiled tubing is unwound from the reel" at column 6, line 60; "dents, wall thinning, cracks" at column 5, line 33), comprising:

a sensing device (figure 4, numeral 52) sensing a condition of the coiled tubing surface (figure 4, numeral 16) as the coiled tubing is being injected into or removed from a well ("as the coiled tubing is unwound from the reel" at column 6, line 60).

While McCoy contemplates any type of sensing device to achieve the desired inspection results (see "particular coiled tubing and test apparatus are neither the present invention nor limiting ..." at column 5, line 42), McCoy does not teach the remaining elements of claim 1 that are directed to image inspection. These elements are addressed in the description of the secondary teachings below.

Kanzaka discloses a system in the same field defect inspection (see figure 1), and in the same problem solving area of detecting and recording defects on a moving body (figure 1, numeral 1), comprising:

An imaging device recording video signals of a segment of a moving body to be inspected (figure 1, numeral 2);

a conductor transmitting the video signals to a flaw detection processor (figure 1, signal "v"); and

a program in the processor configured to execute pattern recognition software and analyze each image separately to detect discrete anomalies on the object (figure 1, numeral 3; "An image or video signal v from the video camera 2 is processed by an inspection machine 3

that is an electronic processor to inspect the existence or not of defects such as flaws, dirty or the like on the surface of the inspected object" column 2, lines 59-62).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the sensor and computer required by McCoy at figure 4, numerals 52 and 54, the camera and image analysis method of taught by Kanzaka (i.e., figure 1, numeral 3) in order to detect flaws on the coiled tubing of McCoy. One would be motivated to utilize the camera and image analysis method of Kanzaka for the following reasons:

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time;

To recognize unwanted defects ("X marks ... cannot be overlooked" at Kanzaka column 3, line 18) and ignore innocuous defects ("O marks ... may be ignored" at Kanzaka column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more

serious defects that could cause failure, and reducing the downtime associated with an operator having to review surface conditions that are not serious, and will not cause failure.

The above McCoy and Kanzaka combination teaches the transmission of video images (figure 1, "v") of the coiled tubing from a video camera (i.e., figure 1, numeral 2 of Kanzaka) to a flaw detection unit (i.e., figure 1, numeral 4 of Kanzaka). While the flaw detection unit receives, accepts and processes of the video signals to detect defects in individual images, details of how the images are converted from a "video" stream to individual images for processing are left out. This is because such rudimentary details are well within the skill level of one of ordinary skill in the art. Therefore, the McCoy and Kanzaka combination does not teach:

An image grabber generating images of the tubing segment from the video signals.

Morrison discloses a defect detection system (figures 1 and 2), wherein he addresses the same problem of capturing and processing images of a moving object (figure 1, numeral 7), comprising:

an image grabber input device (figure 1, numeral 9) receiving the video signals (figure 1, numeral 8) and generating sequential images of the moving object's surface from the video ("captured signals corresponding to each frame of video signals are preferably digitized ..." at column 4, line 38).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the McCoy and Kanzaka, by providing the flaw detection unit (i.e., Kanzaka figure 1, numeral 4) with the video camera/frame grabber arrangement as taught by Morrison (i.e., Morrison figure 1, numerals 6, 8 and 9) to accept and digitize the video signal into discrete

images for subsequent analysis and flaw detection. One skilled in the art would be motivated to make this modification for the following reasons:

In order to process individual images as is required by the Ortiz and Kanzaka combination (i.e., "an image ... is processed" at Kanzaka column 2, line 59) by converting the input video signal, which is a continuous signal representing a plurality of images in serial sequence, into individual digitized images;

The video camera and frame grabber of Morrison are commonly available, off-the-shelf items as described at section 6 of Morrison (i.e., column 7, lines 5-51), thus reducing the cost associated with specialize, custom camera and processors;

The ability to "collect the video information sufficiently quickly that the spatial resolution of the camera is not degraded, and to digitized the information into a large range of numbers representing brightness or gray levels" (Morrison, column 7, line 10), thus producing an accurate image in a short period of time; and

Because of the ability to store the images "in a dedicated area of memory" (Morrison, column 7, line 27) which offers "higher overall system speed" (Morrison, column 7, line 34), thus providing the McCoy and Kanzaka combination with the ability to accurately process more images to ensure that no defects on the moving tubing are missed.

Regarding claim 5 specifically, the frame storage of Morrison stores subsequent frames, and is thus a stacker.

Regarding claims 2 and 3 are met by the above McCoy and Kanzaka combination. That is, Kanzaka discloses, as part of his flaw detection processor (i.e., figure 1, numeral 3), receives location data indicating a position of a defect ("location thereof" at column 3, line 6), and stamps

the coordinates of the defect onto the image of the defect ("composing section 6, the video signal v and the data D ... are mixed to provide a composing signal C which is delivered to a video signal recorder" at column 3, line 37). It would have been obvious at the time the invention was made to one of ordinary skill in the art to mix the location coordinates and images of the above McCoy, Kanzaka and Morrison combination as taught by Kanzaka in order to have a log of the actual images along with locations for future review and analysis of defects, and to pinpoint exactly where on the tubing defects are located for longevity analysis are repair/correction of the tubing.

Regarding claim 6, the limitations therein are met by the McCoy, Kanzaka and Morison combination as described above. That is, in the above combination, the Kanzaka defect detection processor is used to recognize and store defects in the McCoy system. Kanzaka teaches as part of that processing recognizing and classifying defects ("the grades of the defects" at Kanzaka column 4, line 36).

Regarding claim 7, McCoy inspects for "cracks" at column 5, line 33 and the above combination does not change that.

Regarding claim 9, the McCoy, Kanzaka and Morrison generates a warning signal (Kanzaka figure 1, numeral 9 and/or 12).

13. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A), and Morrison et al. (US 5,033,096 A) as applied to claim 1, and further in combination with Terry et al. (US 6,296,066 B1).

The McCoy, Kanzaka and Morrison combination does not teach the specific limitation regarding the coiled tubing as required by claims 43, including an outer-wear layer; and a contrasting layer beneath the wear layer; wherein if the outer wear layer is worn away, the contrasting layer becomes visible as a contrasting feature on the tubing.

Terry discloses a coiled tubing (figure 1, numeral 20) comprising: an outer wear layer ("wear layer 36" at column 10, line 22); and a contrasting layer beneath the wear layer ("underlying load carrying layers 34" at column 10, line 27); wherein if the outer wear layer is worn away, the contrasting layer becomes visible as a contrasting feature on the tubing (the wear layer "can be of a different fiber and color making it easy to determine the wear locations" at column 10, line 33).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the coiled tubing taught by Terry, as the tubing for well deploying and monitoring require by McCoy, in order to make it "easy to determine the wear locations" (Terry, column 10, line 33) due to the color differences between the outer and under layers.

14. Claims 44 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A), Morrison et al. (US 5,033,096 A) and Terry et al. (US 6,296,066 B1) as applied to claim 43, and further in combination with Newman (US 6,321,596 B1).

While the McCoy, Kanzaka, Morrison and Terry combination teaches the inspection of coiled tubing employed in a well (McCoy figure 4; "as the coiled tubing is unwound from the

reel" at column 6, line 60; "dents, wall thinning, cracks" at column 5, line 33), McCoy does not teach the outermost layer individual distinguishable stripes.

Newman teaches a system for inspecting coiled tubing (figure 1), comprising longitudinal stripes on the outer surface of the tubing ("series of visible lines ... along its length" at column 3, line 43). The purpose of the stripes described by Newman is as a reference mark, for visual monitoring via. a camera, from which to monitor tubing characteristics such as rotation ("coiled tubing can be marked and locations of markings can be measured in a variety of ways", "rotational orientation of the line ... is monitored visually, with ... camera(s)" at column 3, lines 40-45; "take discrete rotational measurements at one or at a plurality of locations on a length of coiled tubing while it is being unspooled" at column 3, line 23; the rotation of the tube is a measure of "fatigue damage" at column 4, line 25).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the tubing of the McCoy, Kanzaka, Morrison and Terry combination with longitudinal stripes as taught by Newman, in order to measure the rotational orientation of the tubing as a further indicator of "fatigue", thus improving the accuracy of the inspection by providing the additional criteria of rotational fatigue.

15. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A), and Morrison et al. (US 5,033,096 A) as applied to claim 1, and further in combination with Hametner et al. (US 5,046,852 A).

Claim 8 requires the program to measure the diameter of the tubing.

The McCoy, Kanzaka and Morrison combination does not teach the measurement of diameter.

Hametner discloses a system in the same field of optical tube inspection ("tube material" at column 1, line 52; "optically scanned" at column 2, line 36), comprising the pattern recognition software (the system is computer implemented, and measurements are made by image processing) to measure outside diameter of the tubing ("diameter" at column 1, line 53, and elsewhere) and indicate whether it is outside a user-defined tolerance ("conforms to a desired configuration" at column 2, line 35; "desired configuration within a predetermined tolerance" at column 2, line 44).

It would have been obvious at the time the invention was made to one of ordinary skill in the art adapt the flaw detection processor of the McCoy, Kanzaka and Morrison combination to included, as a further measurement of the tube's physical condition, the outside diameter as taught by Hametner, in order to ensure further ensure conformity with design standards and to ensure a proper tube thickness to prevent failure during use.

16. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Morrison et al. (US 5,033,096 A) as applied to claim 1, and further in combination with Endsley et al. (US 6,05,613 A).

The McCoy, Kanzaka and Morrison combination does not teach 640X480 camera resolution with 8 bits per color.

Endsley discloses an CCD camera comprising 640X480 resolution with 8 bits per color ("Kodak KAI-0320CM", "640 columns and 480 rows", "8-bit" at column 3, lines 26, 28 and 36).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to utilize the CCD camera taught by Endsley, as the camera required by the McCoy, Kanzaka and Morrison combination, in order to keep the system cost low by using a standard, commercially available and off-the-shelf camera, while providing a high quality 640X480 image to ensure an accurate inspection.

17. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Puffer (US 4,563,095 A) and Morrison et al. (US 5,033,096 A).

Regarding claim 26, Puffer discloses a system for automated tubing inspection (figure 1), comprising:

a processing circuit (figure 1, numeral 44);

a camera producing a sequence of images ("CID detector array" at column 5, line 41; this detector produces a continuous sequence of frames; see "scanning raster" at column 5, line 61 and "each frame" at column 6, line 6) of a tubing surface (figure 1, numeral 16; "irregularities in the cable coating" at column 1, line 36; Puffer inspects a cable coating, and the coating itself is a tubular member in that it is hollow on the inside per se.; the claim is open ended and does not preclude the coating, or tubing from being filled, such as with a conductor in the case of Puffer),

a pattern classifier circuit (figure 2, numerals 48, 54 and 52) reading each image separately ("each frame" at column 6, line 7), extracting discrete anomalies of the tubing from the image and comparing the sizes of the anomalies against a user-defined threshold (figure 2,

numeral 52; "counter 52 increments each time a pixel senses light above the threshold level, and provides an output 55 to an annunciator or alarm 56 each time [a] preselected count (i.e., 16) is reached" where "the count is one indicative of a flaw such as a pip 22" at column 6, lines 1-5; "the cumulative count during each scanning frame corresponds to the size of the image on detector 38, and may correspond to the size of a pip 22" at column 6, lines 10-14); and

generating an interrupt indicating that a defect has been located if the pattern classification circuit determines that a size of a discrete anomaly does not fall within the user-defined threshold (This limitation is met in at least two ways: First, whenever the pip size threshold is met, the normal process is interrupted by the recording of the pip size; e.g., see "provide a record of pip sizes during each scanning frame" at column 6, line 15; Second, as mentioned above, an alarm is sounded when the pip size meets the threshold; e.g., see "actuating alarm 56 only if it accumulates the requisite count (i.e., 16)" at column 6, line 31).

Puffer does not teach a computer processor having pattern recognition software do perform the extract the discrete anomalies, and puffer does not teach a separate output device producing video signals of the tubing and an input device receiving the video signals and generating sequential images of the tubing surface from the video input.

Morrison discloses a defect detection system (figures 1 and 2), wherein he addresses the same problem of capturing and processing images of a moving object (figure 1, numeral 7), comprising:

a computer processor having pattern recognition software ("software" at column 4, line 34) extracting discrete anomalies (figure 1, numeral 10; "abrupt change in the brightness" at column 2, line 57), an output device producing video signals of the inspection object (figure 1,

numeral 6; "video camera" at column 4, line 23), an input device receiving the video signals and generating sequential images of the tubing surface from the video input (figure 1, numeral 9; "frame grabber" at column 4, line 33). Specifically, Morrison teaches an image grabber input device (figure 1, numeral 9) receiving the video signals (figure 1, numeral 8) and generating sequential images of the moving object's surface from the video ("captured signals corresponding to each frame of video signals are preferably digitized ..." at column 4, line 38).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the image capture and processing circuit of Puffer (figure 1, numeral 44), by capturing images and implementing the defect detection processing of Puffer utilizing the video camera, frame grabber and patter recognition software as taught by Morrison. One skilled in the art would be motivated to make this modification for the following reasons:

In order to conveniently capture individual images for processing as required by Puffer quickly and efficiently without the need for any specialized hardware as currently disclosed by Puffer;

The video camera and frame grabber of Morrison are commonly available, off-the-shelf items as described at section 6 of Morrison (i.e., column 7, lines 5-51), thus reducing the cost associated with specialize, custom camera and processors;

The ability to "collect the video information sufficiently quickly that the spatial resolution of the camera is not degraded, and to digitized the information into a large range of numbers representing brightness or gray levels" (Morrison, column 7, line 10), thus producing an accurate image in a short period of time; and

Because of the ability to store the images "in a dedicated area of memory" (Morrison, column 7, line 27) which offers "higher overall system speed" (Morrison, column 7, line 34), thus providing the McCoy and Kanzaka combination with the ability to accurately process more images to ensure that no defects on the moving tubing are missed.

18. Claims 27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Puffer (US 4,563,095 A) and Morrison et al. (US 5,033,096 A) as applied to claim 26 above, and further in combination with Ortiz et al. (US 4,988,875 A) and Vild et al. (US 4,123,708 A).

Regarding claim 27, while the Puffer and Morrison combination records data pertaining to identified defects (i.e., Puffer figure 2, numeral 58), the combination does not teach:

An input for receiving location of data indicating the position from which images are taken, and generating an interrupt to transmit an image containing the defect and the corresponding location data to an output device.

Ortiz discloses a system for inspecting coiled tubing (figure 11), comprising an input for receiving location of data indicating the position from which images are taken (figure 11, numeral 128; "location of the cable area being documented" at column 7, line 40), and generating an interrupt to transmit an image containing the defect and the corresponding location data to an output device (whenever a defect is identified by the motion detectors at figure 11, numeral 112, an interrupt is sent via. 116 to record the images of the defect along with the aforementioned location data; see "video signals representing the images of the defective

segment ... are transmitted ... to a video recording system" at column 7, lines 25-30; "the information includes ... location" at column 7, line 39).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the Puffer and Morrison combination with an image and location data recording system for recording the images and the location of the defective portions of the tubing as taught by Ortiz, so that "those images can be evaluated either visually or, by image processing for the purpose of eliminating some cable locations for close inspection" (Ortiz column 7, line 56) thereby filtering out false defects so that real defects can be re-examined more closely to ensure accuracy.

The Puffer, Morrison and Ortiz combination, while recording location data, does not teach markings on the coiled tubing to provide location data on the coiled tubing.

Vild discloses a system for inspecting tubes for flaws ("flaw inspection" and "pipe" at column 3, lines 35 and 37), comprising markings on the coiled tubing to provide location data on the coiled tubing ("marking of the location of the defect" at column 5, line 50; "marking gun" at column 6, line 5).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the Puffer, Morrison and Ortiz combination, to provide a visual "indication not only of the longitudinal location of the defect, but also an indication of the circumferential location of the defect" (Vild column 5, line 53), thereby providing the combination with an easy, intuitive way from which to locate the defects both in the images and on the actual pipe.

Regarding claim 29, while the Puffer, Morrison, Ortiz and Vild combination teaches the recording of defect information (i.e., Puffer figure 2, numeral 58), the combination does not teach a monitor.

Morrison further teaches a monitor for viewing the defect information (figure 1, numeral 11).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide Puffer with a monitor as taught by Morrison so that an operator can easily and readily view the stored defect information to review and possibly confirm the accuracy of the results.

19. Claims 28 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Puffer (US 4,563,095 A), Morrison et al. (US 5,033,096 A), Ortiz et al. (US 4,988,875 A) and Vild et al. (US 4,123,708 A) as applied to claim 27 above, and further in combination with Kanzaka et al. (US 5,680,473 A).

Regarding claim 28, while the Puffer, Morrison, Ortiz and Vild combination teaches the recording of defect information (i.e., Puffer figure 2, numeral 58), the combination does not teach a printer.

Kanzaka discloses a defect inspection system comprising recording defect information on paper via. a printer (figure 1, numeral 9 and figure 2).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to record the defect information (e.g., location) each time the defect alarm is generated by Puffer in order to provide a permanent record of both the defect location so that an operator can

view and further classify the defects to ensure "an accurate judgment to the acceptance or rejection of the defect on the inspected object" as described by Kanzaka, at column 4, lines 26-38, and to provide an intuitive indication of where the defects are in relation to the moving tubing (see figure 2, and column 3, lines 8-15).

Regarding claim 30, Kanzaka discloses his classifier as recognizing unwanted defects ("X marks ... cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks ... may be ignored" at column 3, line 20).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to train the Puffer, Morrison, Ortiz and Vild combination to distinguish between unwanted and innocuous defects as taught by Kanzaka, to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and reduce the dowtime association with an operator having to review surface conditions that are not serious, and will not cause failure.

20. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A) and Kanzaka et al. (US 5,680,473 A), and further in combination with Newman (US 6,321,596 B1) and Reis et al. (US 4,311,905 A).

Regarding claim 13, McCoy discloses an inspection system for coiled tubing employed in a well (figure 4; "as the coiled tubing is unwound from the reel" at column 6, line 60; "dents, wall thinning, cracks" at column 5, line 33), comprising:

a sensing device (figure 4, numeral 52) sensing a condition of the coiled tubing surface (figure 4, numeral 16) as the coiled tubing is being injected into or removed from a well ("as the coiled tubing is unwound from the reel" at column 6, line 60).

While McCoy contemplates any type of sensing device to achieve the desired inspection results (see "particular coiled tubing and test apparatus are neither the present invention nor limiting ..." at column 5, line 42), McCoy does not teach the remaining elements of claim 1 that are directed to image inspection. These elements are addressed in the description of the secondary teachings below.

Kanzaka discloses a system in the same field defect inspection (see figure 1), and in the same problem solving area of detecting and recording defects on a moving body (figure 1, numeral 1), comprising:

An imaging device (figure 1, numeral 2) recording video signals (figure 1, "v") of a segment of a moving body to be inspected (figure 1, numeral 1);

a flaw detection processor receiving the video signals (figure 1, numeral 3); and

a program in the processor configured to execute pattern recognition software and analyze each image separately to detect discrete anomalies on the object (figure 1, numeral 3; "An image or video signal v from the video camera 2 is processed by an inspection machine 3 that is an electronic processor to inspect the existence or not of defects such as flaws, dirty or the like on the surface of the inspected object" column 2, lines 59-62).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the sensor and computer required by McCoy at figure 4, numerals 52 and 54, the camera and image analysis method of taught by Kanzaka (i.e., figure 1, numeral 3) in

order to detect flaws on the coiled tubing of McCoy. One would be motivated to utilize the camera and image analysis method of Kanzaka for the following reasons:

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time; to

Recognizing unwanted defects ("X marks ... cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks ... may be ignored" at column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and reduce the dowtime association with an operator having to review surface conditions that are not serious, and will not cause failure..

While the McCoy and Kanzaka combination teaches the inspection of coiled tubing as it is deployed, the combination does not teach:

A composite coiled tubing having layers of fibers forming the tubing wall;

The outermost layer having a stripe; and

The processor detecting a circumferential position of a defect in reference to the stripe.

Newman teaches a system for inspecting coiled tubing (figure 1), comprising the inspection of a composite coiled tubing ("composites" at column 1, line 12) having layers of fibers forming the tubing wall (layers of fibers is an inherent characteristic of a composite). Newman states that "coiled tubing is made of plastic, composites, titanium or steel" at column 1, line 11.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to inspect, using the McCoy and Kanzaka combination, composite coiled tubing because it is one of the primary materials with which coiled tubing is made.

Furthermore, Newman teaches a longitudinal stripe on the outer surface of the tubing ("a visible line is marked along the coiled tubing" at column 3, line 42). The purpose of this stripe as described by Newman is as a reference mark, for visual monitoring via. a camera, from which to monitor tubing characteristics such as rotation ("coiled tubing can be marked and locations of markings can be measured in a variety of ways", "rotational orientation of the line ... is monitored visually, with ... camera(s)" at column 3, lines 40-45; "take discrete rotational measurements at one or at a plurality of locations on a length of coiled tubing while it is being unspooled" at column 3, line 23; the rotation of the tube is a measure of "fatigue damage" at column 4, line 25).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the tubing of the McCoy and Kanzaka combination with at least one longitudinal stripe for purposes of measuring rotational orientation and "fatigue damage" of the tubing, thereby providing another important measure of the tubing's overall condition.

Finally, while the McCoy, Kanzaka and Newman combination teaches the detection of defects on a composite coil tubing having a stripe, the combination does not teach providing a circumferential position of a defect in reference to the stripe.

Ries discloses a system for inspecting tubing ("testing of pipes" in the title; "tube, pipe, or other hollow" at column 3, line 12), comprising relating defects found during an inspection ("defects" at column 3, line 59) to a reference mark on the tubing itself ("central marking" at column 3, line 35; "the ultrasonic test equipment identified the locations of these defects, e.g. by signals representing he distance of the suspected defects from the central marking on the pipe" at column 3, line 60).

Given the art as a whole, it would have been obvious at the time the invention was made to one of ordinary skill in the art to relate any defects found in the McCoy, Kanzaka and Newman combination to the central marking, or stripe on the composite tubing, so that the defects can be easily located in the circumferential direction during later visual inspection.

21. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A), Newman (US 6,321,596 B1) and Reis et al. (US 4,311,905 A) combination as applied to claim 13 above, and further in combination with Garcia et al. (US 5,923,771 A).

The McCoy, Kanzaka, Newman and Reis combination, while teaching the detection of flaws on the tubing surface, the surface inherently having a color (if it didn't, it would be invisible), does not teach analyzing the tubing surface to detect the color of the tubing segment.

Garcia discloses a system for inspecting an object for flaws from an image ("determine the size of cracks and bubbles in copper bars" at column 2, line 7), comprising analyzing the object surface to detect the color of the object ("identifies the color of each square (white if it corresponds to the background and black if it corresponds to a flaw" at column 3, line 18; "color" at column 3, lie 20).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to adapt the defect detection of the McCoy, Kanzaka, Newman and Reis combination to detect the color of the tubing segment as taught by Garcia, in order to distinguish defects on the tubing that are of a different color than the background because using this method, "there is no problem with regard to the alteration or contamination of the object being measured" (Garcia, column 3, line 35), and it provides a "reliable method of rapid and precise detection which is easy to handle" (Garcia column 1, line 54).

22. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A), Newman (US 6,321,596 B1) and Reis et al. (US 4,311,905 A) as applied to claim 13 above, and further in combination with Ortiz et al. (US 4,988,875 A).

The McCoy, Kanzaka, Newman and Reis combination does not teach the imaging of the tubing using "a plurality of imaging devices" to capture the "outer circumference of the tubing" as required by claim 36.

Ortiz discloses a system for inspecting a coiled tubing for defects (figure 11), comprising imaging the tubing using a plurality of imaging devices to capture the outer circumference of the

tubing ("three ... cameras, positioned to view the cable from angles of 120 degrees from each other, can provide view of the entire bulk of the cable jacket" at column 6, line 57).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the McCoy, Kanzaka, Newman and Reis combination with a plurality of cameras as taught by Ortiz, in order to provide a "view of the entire bulk" of the cable (Ortiz, column 6, line 57) so that no defects are obscured by hidden views when only a single camera is used, thus provide a more complete inspection of the entire circumference.

23. Claims 31, 34 and 37 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A) and Kanzaka et al. (US 5,680,473 A), and further in combination with Ortiz et al. (US 4,988,875 A).

Regarding claim 31, McCoy discloses an inspection system for coiled tubing employed in a well (figure 4; "as the coiled tubing is unwound from the reel" at column 6, line 60; the tubing is inspected for "dents, wall thinning, cracks", etc. at column 5, line 33), comprising:

a sensing device (figure 4, numeral 52) sensing a condition of the coiled tubing surface (figure 4, numeral 16) as the coiled tubing is being injected into or removed from a well ("as the coiled tubing is unwound from the reel" at column 6, line 60).

While McCoy contemplates any type of sensing device to achieve the desired inspection results (see "particular coiled tubing and test apparatus are neither the present invention nor limiting ..." at column 5, line 42), McCoy does not teach the remaining elements of claim 31 that are directed to image inspection. These elements are addressed in the description of the secondary teachings below.

Kanzaka discloses a system in the same field defect inspection (see figure 1), and in the same problem solving area of detecting and recording defects on a moving body (figure 1, numeral 1), comprising:

an imaging device (figure 1, numeral 2) recording video signals (figure 1, "v") of a segment of a moving body to be inspected (figure 1, numeral 1);

a flaw detection processor receiving the video signals (figure 1, numeral 3); and

a program in the processor configured to execute pattern recognition software and analyze each image separately to detect discrete anomalies on the object (figure 1, numeral 3; "An image or video signal v from the video camera 2 is processed by an inspection machine 3 that is an electronic processor to inspect the existence or not of defects such as flaws, dirty or the like on the surface of the inspected object" column 2, lines 59-62).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the sensor and computer required by McCoy at figure 4, numerals 52 and 54, the camera and image analysis method of taught by Kanzaka (i.e., figure 1, numeral 3) in order to detect flaws on the coiled tubing of McCoy. One would be motivated to utilize the camera and image analysis method of Kanzaka for the following reasons:

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time; to

Recognizing unwanted defects ("X marks ... cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks ... may be ignored" at column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and thus reduce the downtime associated with an operator having to review surface conditions that are not serious, and will not cause failure.

The McCoy and Kanzaka combination does not teach the imaging of the tubing using "a plurality of imaging devices" to capture the "outer circumference of the tubing" as required by claim 31.

Ortiz discloses a system for inspecting a coiled tubing for defects (figure 11), comprising imaging the tubing using a plurality of imaging devices to capture the outer circumference of the tubing ("three ... cameras, positioned to view the cable from angles of 120 degrees from each other, can provide view of the entire bulk of the cable jacket" at column 6, line 57).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the McCoy and Kanzaka combination with a plurality of cameras as taught by Ortiz, in order to provide a "view of the entire bulk" of the tubing (Ortiz, column 6, line 57) so that no defects are obscured by hidden views when only a single camera is used, thus ensuring complete inspection of the entire circumference.

Regarding claim 34, the limitations therein are met by the McCoy, Kanzaka and Ortiz combination described above. That is, Kanzaka teaches the transmission of a location counter (Kanzaka figure 1, numeral 1') to the processor (Kanzaka figure 1, the "I" signal traveling to numeral 3) to identify the poison along the moving body at which images are taken ("such distance data will be contained in data D" at Kanzaka column 3, line 67; data "D" is merged with the captured images as described at column 3, lines 40-43). Further, Kanzaka teaches a display of the images (figure 1, numeral 12). All these limitations are incorporated into the inspection system of McCoy per the aforementioned combination.

Regarding claim 37, the McCoy, Kanzaka and Ortiz combination teaches plural cameras (i.e., Ortiz figure 11, numerals 36) that are utilized to capture the images required by the McCoy and Kanzaka combination. Ortiz also teaches illumination sources are required by claim 37 (Ortiz figure 11, numerals 25). It would have been obvious to include the illumination sources of Ortiz in the combination in order to properly illuminate the tubing under inspection so that a well defined, high contrast image is captured to ensure defect detection accuracy. The combination does not teach transmitting power to the image devices and illumination sources. However, this would have been obvious to one skilled in the art in order to operate the devices, given that both the light sources and cameras require power to operate (the examiner is unaware of any cameras or light sources that don't require power).

24. Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Ortiz et al. (US 4,988,875 A) as applied to claim 31, and further in combination with Newman (US 6,321,596 B1).

While the McCoy, Kanzaka and Ortiz combination teaches the image inspection of coiled tubing as it is being deployed (i.e., figure 4, numeral 52), comprising a guide roller mechanism and a storage reel (both seen in McCoy figure 1), the combination does not teach the placement of the cameras, and hence the apertures in close proximity to the guide rollers as required by claim 33.

Newman discloses a system for inspecting coiled tubing as it is being deployed, comprising the placement of sensors, including cameras (figure 3, numeral 100), in close proximity to the guide rollers (figure 1, numeral 203).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to place the cameras of the McCoy, Kanzaka and Ortiz combination in close proximity to the guide rollers as taught by Newman, in order to place them in an area between the spool and the guide rollers where an unobstructed image of the entire circumference of the tubing can be obtained as the tubing is spooled off the reel, thereby ensuring a complete coverage of the inspected area.

25. Claim 42 is unpatentable over the combination of the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Ortiz et al. (US 4,988,875 A) as applied to claim 31, and further in combination with Husseiny (US 5,210,704 A).

While the McCoy, Kanzaka and Ortiz combination processes images to detect defects, the combination does not teach determining if the size of previously recognized anomaly has grown beyond a user-designated percentage of its original size.

Husseiny discloses a system in the field of defect inspection and failure analysis, comprising identifying an anomaly as a defect by determining if a size has grown beyond a percentage of its original size (figure 17).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to monitor defect growth on the coiled tubing of the McCoy, Kanzaka and Ortiz combination, and thereby identifying defects when a threshold has been reached as taught by Husseiny, in order to identify "incipient failures ... during operation" and provide an indication to the operation of the tube's "expected life" along with "a warning for the remaining time until failure of the equipment" (Husseiny, column 4, lines 40-54), thereby providing the operator with the ability to predict a failure before it actually occurs in order to take appropriate action and avoid costly losses during an operation.

26. Claim 35 is unpatentable over the combination of the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Ortiz et al. (US 4,988,875 A) as applied to claim 34, and further in combination with Vild et al. (US 4,123,708 A).

Regarding claim 35, the McCoy, Kanzaka and Ortiz combination does not teach markings indicating the position of the discrete anomalies in the tubing.

Vild discloses a system for inspecting tubes for flaws ("flaw inspection" and "pipe" at column 3, lines 35 and 37), comprising markings on the coiled tubing to provide location data on

the coiled tubing ("marking of the location of the defect" at column 5, line 50; "marking gun" at column 6, line 5).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to modify the McCoy, Kanzaka and Ortiz combination to provide markings on the tubing where discrete anomalies are detected as taught by Vild, thereby providing a visual "indication not only of the longitudinal location of the defect, but also an indication of the circumferential location of the defect" (Vild column 5, line 53). These markings provide the combination with an easy, intuitive way from which to subsequently locate the defects both in the images and on the actual pipe.

27. Claims 38 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Ortiz et al. (US 4,988,875 A) as applied to claim 31, and further in combination with McCafferty et al. (US 6,273,188 B1).

The McCoy, Kanzaka and Ortiz combination does not teach camera location, and therefore does not teach placing the camera system on a levelwind that is coupled to a reel of the tubing. However, McCoy teaches the taking of measurements of the tubing as it is spooled from a reel onto a roller track (McCoy figures 1-3), and McCoy teaches sensor placement in an area where the tubing can be inspected as it passes the sensor (figure 4, numeral 52).

McCafferty teaches the spooling of coiled tubing from a reel onto a roller track (figure 1), comprising a levelwind (figure 1, numeral 26) coupled to a reel of the tubing (as depicted in figure 1).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to attach the camera system of the McCoy, Kanzaka and Ortiz combination to a levelwind coupled to a reel of the tubing as taught by McCafferty, thereby providing a stable platform for the camera system to clearly capture images of the tubing as it is being spooled or unspoiled from the reel.

28. Claims 39 and 40 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of McCoy et al. (US 5,767,671 A), Kanzaka et al. (US 5,680,473 A) and Ortiz et al. (US 4,988,875 A) as applied to claim 31, and further in combination with Morrison et al. (US 5,033,096 A).

Regarding claim 39, the McCoy, Kanzaka and Ortiz combination captures video images and transmits them to a defect detection processor (Kanzaka figure 1, numerals 2-3). The combination does not teach storing the images on a recordable media prior to processing the images.

Morrison teaches a system for visually inspecting a moving article (figure 1), comprising capturing video images (figure 1, numeral 6) and storing the images on a recordable media (figure 1, numeral 9, "framestore") prior to processing (figure 1, numeral 10). That is, Morrison teaches an image grabber input device (figure 1, numeral 9) receiving the video signals (figure 1, numeral 8) and generating sequential images of the moving object's surface from the video ("captured signals corresponding to each frame of video signals are preferably digitized ..." at column 4, line 38).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to store the video images of the McCoy, Kanzaka and Ortiz combination (i.e., the "v" signal indicated at Kanzaka figure 1) prior to processing the images (i.e., Kanzaka figure 1, numeral 3) as taught by Morrison. One would be motivated to incorporate the digitizer/framestore of Morrison into the above combination for the following reasons:

To provide a storage device for the images to ensure that none were lost or corrupted in the event of a power failure or glitch;

To process individual images as is required by the McCoy, Kanzaka and Ortiz combination (i.e., "an image … is processed" at Kanzaka column 2, line 59) by converting the input video signal, which is a continuous signal representing a plurality of images in serial sequence, into individual digitized images;

Because of the ability to "collect the video information sufficiently quickly that the spatial resolution of the camera is not degraded, and to digitized the information into a large range of numbers representing brightness or gray levels" (Morrison, column 7, line 10), thus producing an accurate image in a short period of time; and

Because of the ability to store the images "in a dedicated area of memory" (Morrison, column 7, line 27) which offers "higher overall system speed" (Morrison, column 7, line 34), thus providing the McCoy and Kanzaka combination with the ability to accurately process more images to ensure that no defects on the moving tubing are missed.

Regarding claim 40, given that Kanzaka, as part of the McCoy, Kanzaka and Ortiz combination described above, teaches a position counter (i.e., Kanzaka figure 1, numeral 1') whereby the counter value is transmitted to the processor 3 for storage with the images, it would

have been obvious to include and store those values with the images for the same reasons and motivation provided in the claim 39 rejection above (i.e., so they are not lost or corrupted in the event of a power failure, etc.).

29. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination Lam (US 5,043,663 A) and Kanzaka et al. (US 5,680,473 A), and further in combination with Newman (US 6,321,596 B1).

Regarding claim 13, Lam discloses:

a tubing ("pipe associated with oil and gas wells" at column 4, line 8), the outermost layer having a longitudinal stripe ("longitudinal seam" at column 6, line 64);

an inspection device taking readings of a segment of the coiled tubing ("inspection head 12" at column 5, line 28) as the coiled tubing is presented before the imaging device ("inspected during removal from the well" at column 4, line 12).

a processor receiving the inspection signals from the inspection head (figures 1 and 2, numeral 18); and

a program in the processor ("computer program" at column 10, line 52) analyzing the inspection signals to detect a circumferential position of a defect in reference to the stripe (figure 4A; the defects are represented at numerals 50, in relation to their longitudinal and circumferential positions with respect to each other; pipes having the aforementioned seam, while not necessarily depicted in figure 4A, would also appear here as plotted data is clear from column 6, lines 65-68; thus, defects are plotted in relation to the seam).

Lam inspects tubing for such defects as “inclusions”, “gouges”, (both at column 1, lines 20-21), “mechanical damage, pitting and fatigue cracks” (column 1, line 40). While Lam indicates that any type of inspection device “capable of generating a suitable defect signal” (column 5, line 38) can be used in the context of the invention, and while Lam suggests “visual inspection” (column 6, line 52), Lam does not teach:

An imaging device recording video signals of the coiled tubing, where the processor receives the **video signals from the imaging device**; and

Where the program in the processor analyzes the inspection signals **video signals to detect the defects.**

Kanzaka discloses a system in the same field of optical defect inspection (see figure 1), and in the same problem solving area of detecting and recording defects on a moving body (figure 1, numeral 1), comprising computer analysis of individual images in order to determine the presence of a defect (figure 1, numeral 3; “An image or video signal v from the video camera 2 is processed by an inspection machine 3 that is an electronic processor to inspect the existence or not of defects such as flaws, dirty or the like on the surface of the inspected object” column 2, lines 59-62).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to employ, as the inspection method required by Lam, the computer image analysis processor taught by Kanzaka (i.e., figure 1, numeral 3). One would be motivated to utilize the processor of Kanzaka for the following reasons:

Computer processors are faster than discrete analog circuitry, and the algorithms can be modified, updated or changed without major hardware adjustments;

In order to provide the operator with a complete set of the necessary data for the inspected object so that any defects and their locations are "readily apparent" (Kanzaka column 4, line 10), so that "an accurate judgment to the acceptance or rejection of the defect on the inspected object 1 can be made" (Kanzaka column 4, line 33A);

To provide the additional benefit of sorting "the grades of the defects" (Kanzaka column 4, line 36) which further assists on operator in separating potential defects from serious defects;

To minimize storage requirements by only storing the necessary data and images of defects ("minimum usage" at Kanzaka column 4, line 24);

To provide an increase in the "inspection speed" (Kanzaka column 1, line 39) thus allowing the tubing to be inspected at a higher speed, thereby reducing inspection time; to

Recognizing unwanted defects ("X marks ... cannot be overlooked" at column 3, line 18) and ignoring innocuous defects ("O marks ... may be ignored" at column 3, line 20) thus distinguishing between unwanted and innocuous defects to further improve accuracy by flagging innocuous defects as such, and directing the operator's attention to more serious defects that could cause failure, and reduce the downtime association with an operator having to review surface conditions that are not serious, and will not cause failure.

The Lam and Kanzaka combination does not teach the tubing as **having layers of fibers.**

Newman also teaches a system for inspecting a coiled tubing (figure 3), comprising the inspection of a composite tubing ("coiled tubing" and "composites" at column 1, lines 8 and 11)

having layers of fibers ("composite" pipes have layers of fibers), the outermost layer having a longitudinal stripe ("visible line" at column 3, line 42).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to inspect composite tubing, such as the tubing taught by Newman, using the system of the Lam and Kanzaka combination, because the oil and gas well tubing that Lam seeks to inspect includes not only metal tubing as taught by Lam, but also plastic and composite tubes as taught by Newman (column 1, line 11). One would be motivated to inspect composite tubing because it is commonly used in the industry, and also requires the same types of inspection for flaws and imperfections and the Lam and Kanzaka is ideally suited to do so, because it uses image analysis and can distinguish the stripe of the Newman tubing from the other defects using the defect plot of Lam at figure 4A.

30. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination Lam (US 5,043,663 A), Kanzaka et al. (US 5,680,473 A) and Newman (US 6,321,596 B1) as applied to claim 13, and further in combination with Ortiz et al. (US 4,988,875 A).

The Lam, Kanzaka and Newman combination does not teach the imaging of the tubing using "a plurality of imaging devices" to capture the "outer circumference of the tubing" as required by claim 36.

Ortiz discloses a system for inspecting a coiled tubing for defects (figure 11), comprising imaging the tubing using a plurality of imaging devices to capture the outer circumference of the tubing ("three ... cameras, positioned to view the cable from angles of 120 degrees from each other, can provide view of the entire bulk of the cable jacket" at column 6, line 57).

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the Lam, Kanzaka and Newman combination with a plurality of cameras as taught by Ortiz, in order to provide a "view of the entire bulk" of the cable (Ortiz, column 6, line 57) so that no defects are obscured by hidden views when only a single camera is used, thus provide a more complete inspection of the entire circumference.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian P. Werner whose telephone number is 703-306-3037. The examiner can normally be reached on M-F, 8:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bhavesh M. Mehta can be reached on 703-308-5246. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Brian Werner
Primary Examiner
Art Unit 2621
February 16, 2005

BRIAN WERNER
PRIMARY EXAMINER